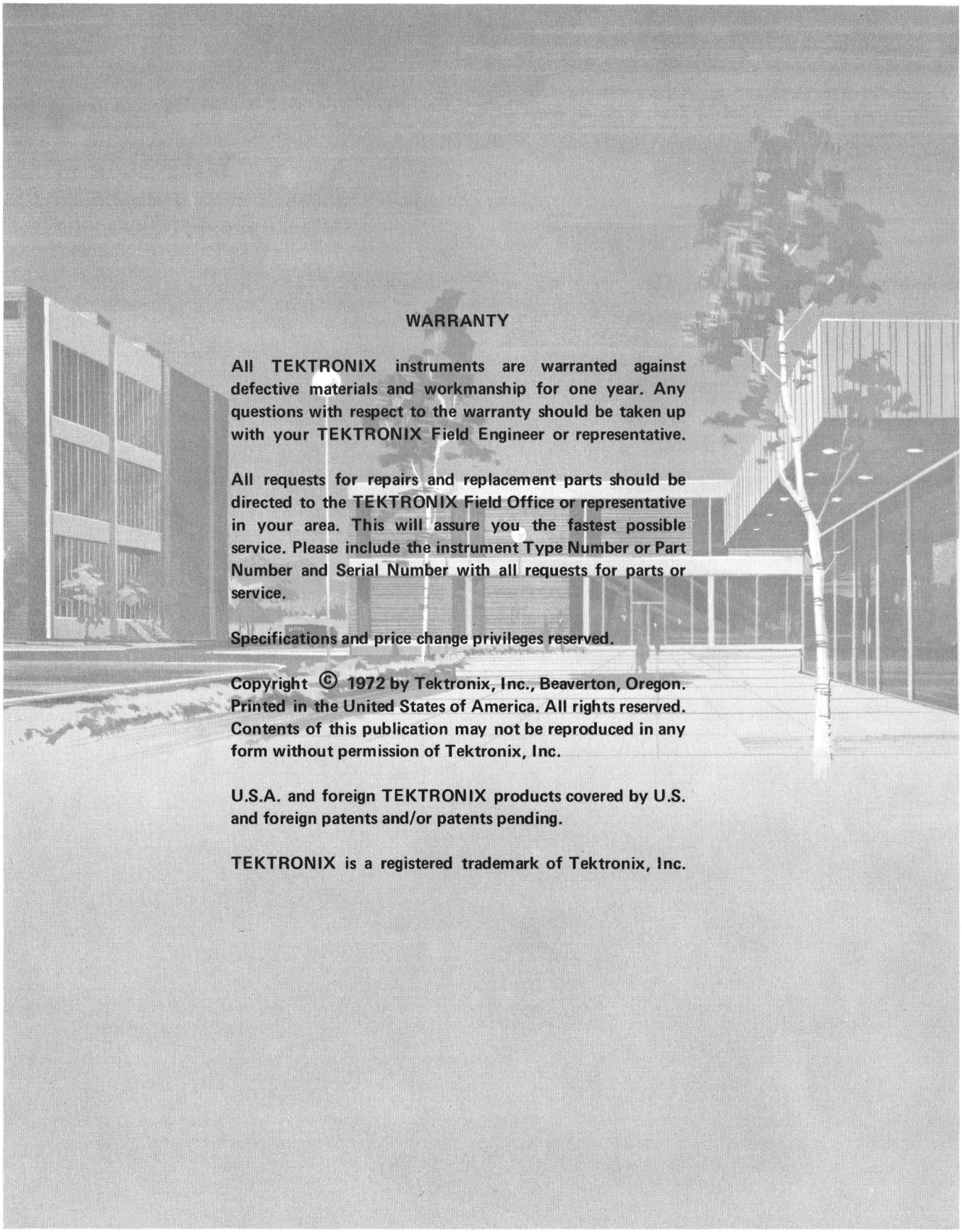
INSTRUCTION MANUAL

Serial Number _____

137 AND 138
CHROMINANCE/LUMINANCE GAIN NORMALIZER

Tektronix, Inc. ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-1311-00



WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

Specifications and price change privileges reserved.

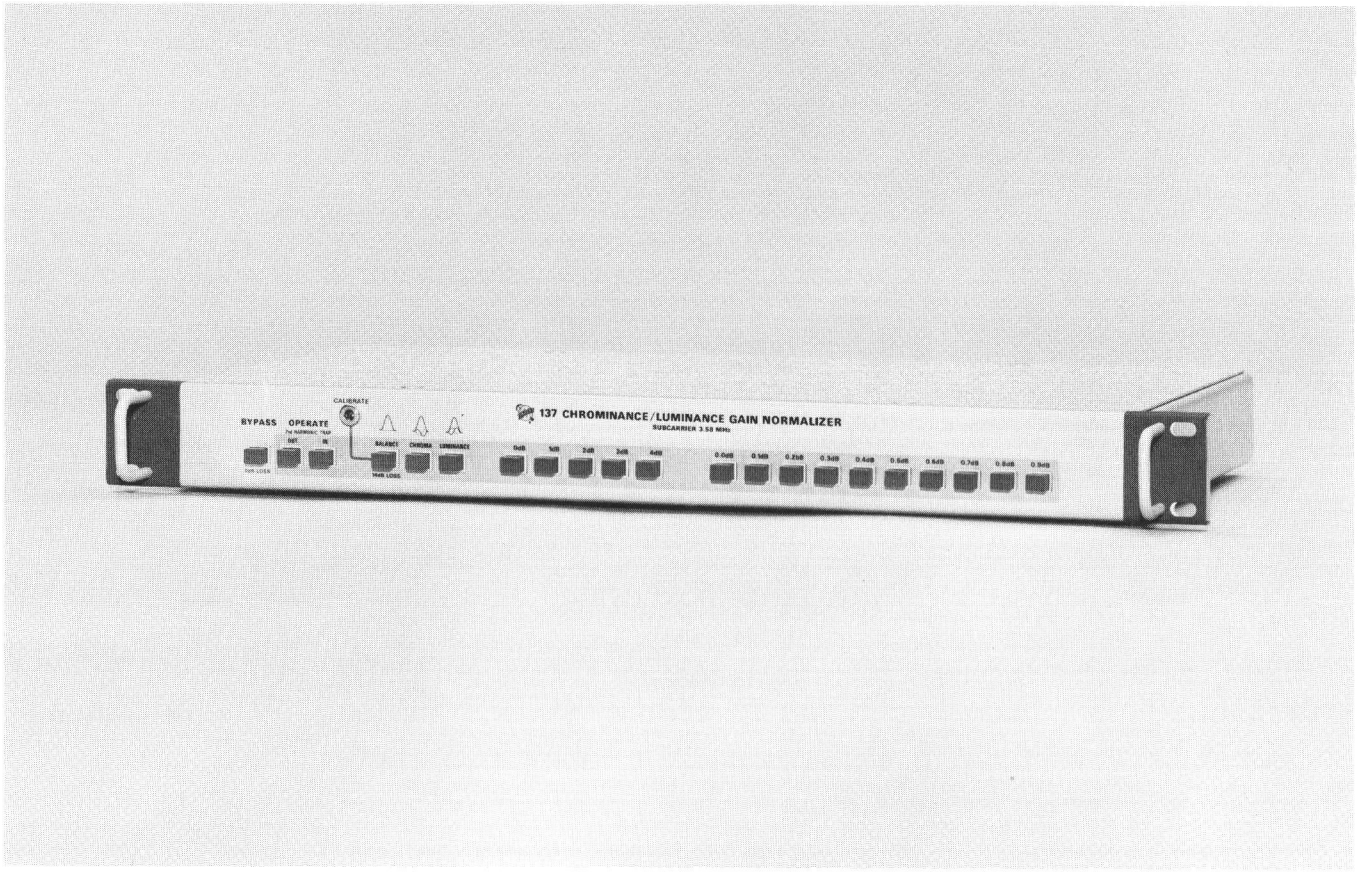
Copyright © 1972 by Tektronix, Inc., Beaverton, Oregon. Printed in the United States of America. All rights reserved. Contents of this publication may not be reproduced in any form without permission of Tektronix, Inc.

U.S.A. and foreign TEKTRONIX products covered by U.S. and foreign patents and/or patents pending.

TEKTRONIX is a registered trademark of Tektronix, Inc.

TABLE OF CONTENTS

SPECIFICATIONS	Page
General Information	1
Electrical Characteristics	1
Accessories	1
OPERATING INSTRUCTIONS AND APPLICATIONS	
Theory of Operation	2
Operating and Measurement Techniques	2
Chrominance/Luminance Gain Distortion	3
Chrominance/Luminance Gain and Delay Distortion	4
MAINTENANCE AND CALIBRATION	
Obtaining Replacement Parts	5
Parts Removal and Replacement	5
Performance Check/Calibration	6
Recommended Test Equipment	6
Procedure	7
Nomographs	12, 13, 14
Electrical Parts List	15



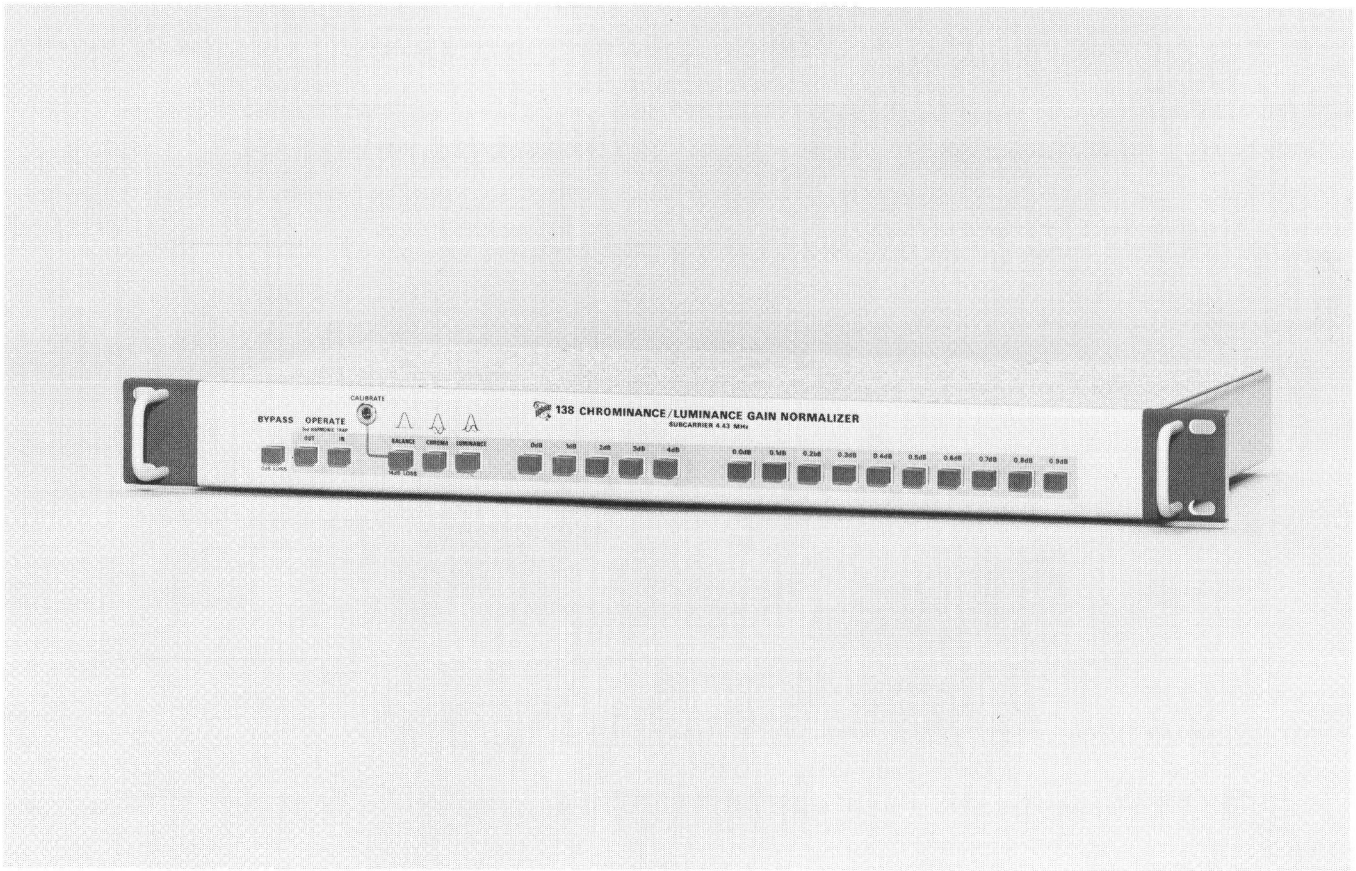


Fig. 1. 137 and 138 Chrominance/Luminance Gain Normalizers.

137 and 138

SPECIFICATION

General Information

The 137 and 138[1] CHROMINANCE/LUMINANCE GAIN NORMALIZERS are **passive devices** for use with a Modulated Sine-Squared Pulse test signal. Chrominance/luminance gain distortion of the modulated pulse can be normalized, to facilitate the measurement of any delay distortion present. With the gain distortion normalized, delay distortion is more easily and accurately measured.

The Normalizers are used for signal analysis only; they are intended to measure, not to eliminate, test signal distortion.

The Normalizers are intended for rackmount installation. Either unit is 1 3/4 inches high.

TABLE 1

ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
INPUT		
Impedance	75 Ω	
Return Loss		
BYPASS	46 dB to 6 MHz.	This mode used for all other waveform observation.
OPERATE	At least 34 dB for all components of Modulated Sine-Squared Pulse.	
Insertion Loss		
BYPASS	0 dB.	
OPERATE	14 dB with attenuators set to 0.0 dB.	
Attenuation		
dB Switches	0 to 4.9 dB in 0.1 dB increments.	
Accuracy	Within 0.1 dB.	
CALIBRATE		
Range	Relative Chrominance/Luminance Gain Variation of at least 0.3 dB.	Compensates any apparent chrominance/luminance gain error in monitor oscilloscope or waveform monitor. Must be set with monitor or oscilloscope sensitivity appropriate to the measurement. If monitor used is the Tektronix Type 529, use X5 gain (14 dB).
Subcarrier 2nd Harmonic Attenuation	At least 20 dB.	OPERATE IN switch depressed.
OUTPUT		
Impedance	75 Ω.	

Accessories

The standard accessories supplied with the 137 and 138 can be found on the Mechanical Parts List Illustrations; rackmounting screws and plastic washers are provided.

[1] **The 137 and 138 are electrically identical. The 137 is for use with 525/60 color standards, and the 138 is for use with 625/50 colour standards.**

OPERATING INSTRUCTIONS AND APPLICATIONS

It is recommended that the user of this instrument refer to the following bibliography as a supplementary source of information.

—Charles W. Rhodes, "The 12.5T Modulated Sine-Squared Pulse for NTSC"; Presented by the author at the 21st Annual Broadcase Symposium of the IEEE Group on Broadcasting (Washington, D.C. — 9-23/24-71); To be published in the IEEE Transactions on Broadcasting in the Spring of 1972.

—A. Kastelein, "A New Sine-Squared Pulse and Bar Shaping Network"; IEEE Transactions on Broadcasting, Vol. BC-16, No. 4, Pgs. 84—89; December, 1970.

—A. M. Lessman, "Subjective Effects of Delay Difference Between Luminance and Chrominance Information of the NTSC Color Television Signal"; Journal of the SMPTE, Vol. 80, No. 8, August, 1971.

Theory of Operation

For the discussion that follows, refer to the diagram provided on a separate pull-out page at the rear of the manual.

The Modulated Sine-Squared Pulse test signal is applied to the Normalizer INPUT. In BYPASS (BYPASS switch depressed), the signal at the INPUT is directly shunted to the OUTPUT.

In either OPERATE mode, the Modulated Sine-Squared Pulse test signal is applied to two specially designed filters. These filters separate the chrominance and luminance portions of the test signal into separate signal paths for further processing.

With the Normalizer BALANCE switch depressed, the signals from the filters are added together at the output, forming a Modulated Sine-Squared Pulse test signal identical in shape to that of the input, but attenuated 14 dB. In this mode, a front-panel adjustment (L13—CALIBRATE) may be used to compensate for any apparent chrominance/luminance gain distortion in the monitoring oscilloscope or waveform monitor.

When the Normalizer CHROMINANCE switch is depressed, the chrominance signal from the chrominance filter is applied to the push button attenuators. The luminance signal is fed to the output with 14 dB attenuation. If the LUMINANCE switch is depressed, the luminance signal is applied to the push button attenuators. The chrominance signal is fed to the output summing point with 14 dB attenuation.

The push button attenuators have an attenuation range of 0 to 4.9 dB. These may be used to correct relative chrominance/luminance gain distortion in 0.1 dB steps. After the gain distortion has been corrected, the attenuated signal is added to the other signal at the output for display on the monitor oscilloscope or waveform monitor.

Any second harmonic of the subcarrier frequency will be attenuated by at least 20 dB when the Normalizer OPERATE IN switch is depressed. Second harmonic of the chrominance of the test signal may introduce measurement errors, thus a switchable filter is provided to detest its presence and reject the distortion.

Operating and Measurement Techniques

The following discusses the various distortions which can be measured using the Normalizer. The waveform photographs shown were obtained using the 137, but also apply to the 138. A Tektronix 147 NTSC Test Signal Generator and Tektronix Type 529 Waveform Monitor were used as the signal source and monitor device.

NOTE

Before proceeding with the Operating and Measurement Techniques, the Normalizer may be adjusted to compensate for small frequency response errors in the monitor oscilloscope or waveform monitor used. Proceed as follows:

1. Connect the modulated sine-squared pulse generator output to the Normalizer INPUT via a 75 Ω coaxial cable.

2. From the Normalizer OUTPUT, connect a 75 Ω coaxial cable to the monitor oscilloscope or waveform monitor input. Properly terminate the line into 75 Ω.

3. Press the Normalizer BYPASS switch. Adjust the monitor oscilloscope or waveform monitor to view the modulated sine-squared pulse. Note the shape of the pulse at the baseline.

4. Press the Normalizer OPERATE OUT and BALANCE switches.

5. Increase the vertical gain of the monitor oscilloscope or waveform monitor 5 times to compensate for the 14 dB insertion loss in the OPERATE mode.

6. Adjust the Normalizer front-panel CALIBRATE control to match the shape of the modulated sine-squared pulse with that noted in step 3.

CHROMINANCE/LUMINANCE GAIN DISTORTION. With the Normalizer in BYPASS, assume an incoming Modulated Sine-Squared Pulse signal (shown in Fig. 2B) is applied to the Normalizer. (Fig. 2A shows normal Modulated Sine-Squared Pulse for comparison purposes.) The photo shows the effect of relative chrominance/luminance gain distortion with no delay distortion. As indicated, gain distortion produces a cosinusoidal variation in the baseline. When chrominance gain is less than luminance gain, Y will be in a positive direction, and can be expressed in negative dB values. (–dB ≡ chrominance gain less than luminance gain.) If Y is negative (dashed lines in Fig. 2B) chrominance gain greater than luminance gain is indicated, and can be expressed in positive dB values.

To measure this distortion, three methods are suggested.

Pulse and Bar. Compute the distortion by using the formula:

$$dB = 20 \log_{10} \frac{A - [|Y| + B]}{A},$$

where A, Y, and B are as defined in Fig. 2B.

Nomograph. Using the MODULATED SIN^2 PULSE APPLICATION NOMOGRAPHS included in this manual, interpolate to determine the distortion. Use of the nomographs is self-explanatory by referring to the legends.

Normalizer. Read the distortion in dB directly from the depressed push-button attenuator switches on the Normalizer front panel. Since the chrominance signal is of lower amplitude than the luminance signal, the luminance signal must be attenuated to match the chrominance signal. Press the Normalizer OPERATE OUT and LUMINANCE switches, and select enough attenuation so that no apparent chrominance/luminance gain distortion is evident. This condition is shown in Fig. 3, and exists when the baseline of the modulated pulse is flat. Read the chrominance/luminance gain distortion in dB from the Normalizer front panel. (See Table 2 for dB to percentage conversion.)

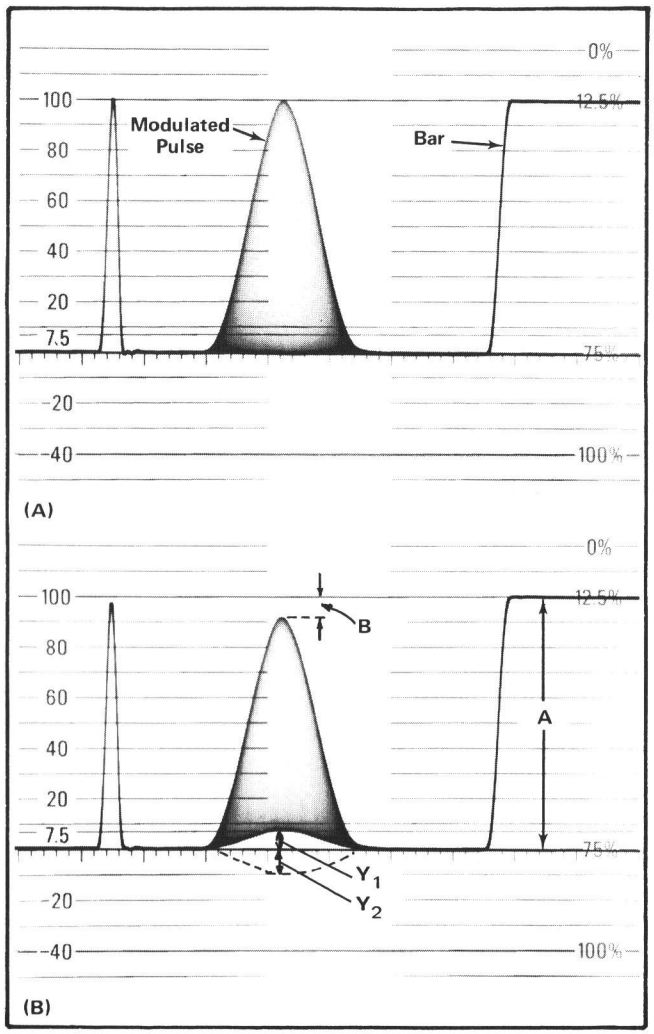


Fig. 2. (A) Normal Modulated Sine-Squared Pulse and (B) Modulated Sine-Squared Pulse with gain distortion.

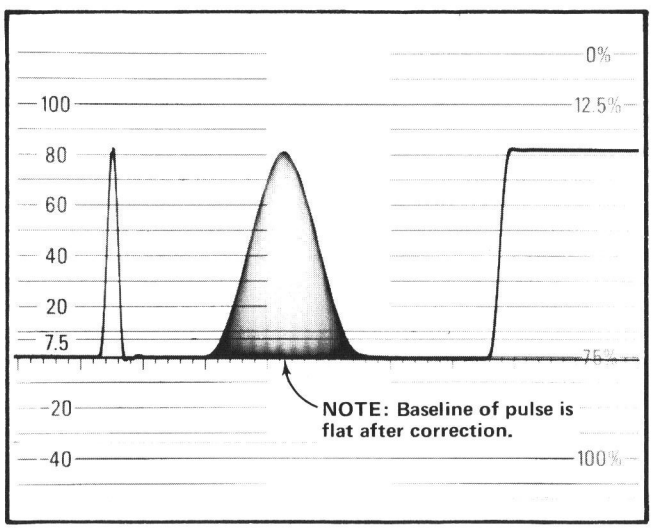


Fig. 3. Modulated Sine-Squared Pulse with no apparent chrominance/luminance gain distortion after correction in normalizer.

TABLE 2

RELATIVE CHROMA/LUM GAIN dB to % CONVERSION

Chrominance Gain Less than Luminance Gain, –dB
(Luminance Attenuation)

dB	–0.0	–0.1	–0.2	–0.3	–0.4	–0.5	–0.6	–0.7	–0.8	–0.9
–0	100.0	98.85	97.72	96.60	95.50	94.41	93.33	92.26	91.21	90.16
–1	89.13	88.10	87.10	86.10	85.11	84.14	83.18	82.22	81.28	80.35
–2	79.43	78.52	77.63	76.74	75.86	74.99	74.13	73.28	72.44	71.62
–3	70.79	69.98	69.19	68.39	67.61	66.84	66.07	65.32	64.57	63.83
–4	63.10	62.38	61.66	60.96	60.26	59.56	58.89	58.21	57.50	56.89

Chrominance Gain Greater than Luminance Gain, +dB
(Chrominance Attenuation)

dB	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	100.0	101.2	102.3	103.5	104.7	105.9	107.2	108.4	109.6	110.9
1	112.2	113.5	114.8	116.2	117.5	118.9	120.2	121.6	123.1	124.5
2	125.9	127.4	128.8	130.3	131.8	133.4	134.9	136.5	138.1	139.6
3	141.3	142.9	144.5	146.2	147.9	149.6	151.4	153.1	154.9	156.7
4	158.5	160.3	162.2	164.1	166.0	167.9	169.8	171.8	173.8	175.8

If the incoming Modulated Sine-Squared Pulse has more chrominance than luminance, select the CHROMINANCE switch rather than the LUMINANCE switch and measure the distortion as explained previously.

CHROMINANCE/LUMINANCE GAIN and DELAY DISTORTION. With the Normalizer in BYPASS, assume an incoming Modulated Sine-Squared Pulse signal (shown in Fig. 4) is applied to the Normalizer. The photo shows the effect of relative chrominance/luminance gain distortion as well as delay distortion. As indicated, chrominance gain is less than luminance gain.

Two methods are suggested to measure the gain distortion and delay distortion.

Nomograph. Using the MODULATED SIN^2 PULSE APPLICATION NOMOGRAPHS included in this manual, interpolate the distortions. Use of the nomographs is self-explanatory by referring to the legends. (When using the nomographs, it may be difficult to resolve and accurately measure delay distortion when gain distortion is large.)

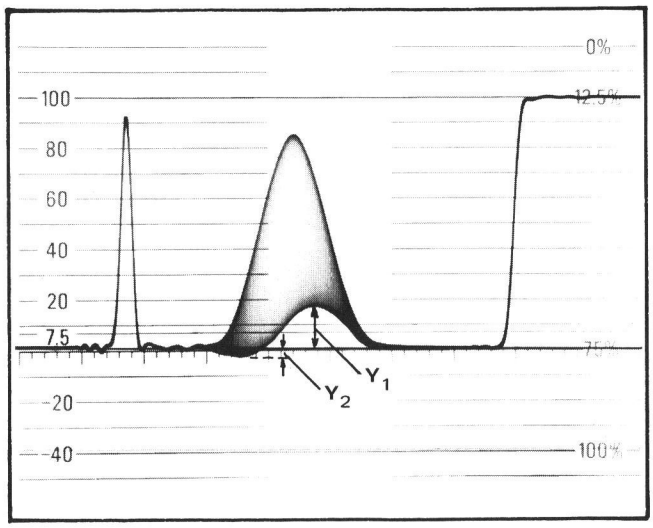


Fig. 4. Modulated Sine-Squared Pulse with chrominance/luminance gain distortion and delay distortion.

Normalizer. Read the gain distortion in dB directly from the depressed push button attenuator switches on the Normalizer front panel, then compute the delay distortion. Since the chrominance signal is of lower amplitude than the luminance signal, the luminance signal must be attenuated to match the chrominance signal. Press the Normalizer OPERATE OUT and LUMINANCE switches, and select enough attenuation so that no apparent chrominance/luminance gain distortion is evident. This condition exists when Y1 and Y2 are equal (see Fig. 5A). Read the chrominance/luminance gain distortion in dB from the Normalizer front panel.

Next, readjust the monitor variable gain control to bring the modulated pulse amplitude back to normal (see Fig. 5B). Measure Y1 and Y2; calculate the delay distortion as follows:

1. If the HAD (Half Amplitude Duration) of the pulse is 2.5 μs (20T),

Delay in nanoseconds = (|Y1| + |Y2|) (15.9).

2. If the HAD of the pulse is 1.57 μs (12.5T),

Delay in nanoseconds = (|Y1| + |Y2|) (10).

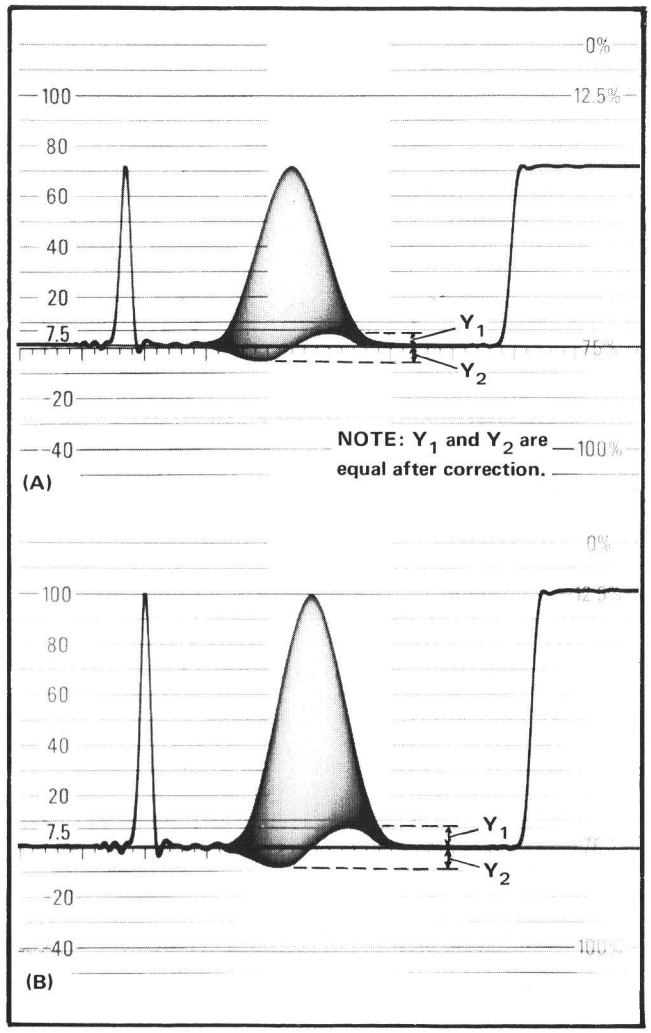


Fig. 5. (A) Modulated Sine-Squared Pulse after correction in Normalizer and (B) same as (A) with increased vertical gain to aid delay distortion measurement.

MAINTENANCE AND CALIBRATION

Obtaining Replacement Parts

All electrical and mechanical replacement parts for the Normalizers can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than that required to order ffrom Tektronix, Inc. Before purchasing or ordering parts, consult the Parts List for value, tolerance, and rating.

Parts Removal and Replacement

Most parts in the Normalizers can be replaced without detailed instructions. Some, however, are best removed and replaced by using specific procedures.

Circuit Board. To remove and replace the circuit board, the front-panel CALIBRATE control and all switch knobs must be removed. A 5/32-inch hex wrench is required to remove the CALIBRATE control; the switch knobs are removed by grasping the knob tightly and pulling straight away from the front-panel.

Switches. To remove a defective switch, the entire circuit board must be removed. Then, using a desoldering tool, unsolder all contacts on the group of switches containing the defective switch (e.g., BYPASS/OPERATE OUT/OPERATE IN, BALANCE/CHROMINANCE/LUMINANCE, 0 dB–4 dB, and 0.0 dB–0.9 dB). Once the group of switches has been removed, the defective switch can be replaced.

Performance Check/Calibration

The following procedure checks and/or calibrates the instrument to the performance requirements listed in the center column of Table 1. Limits and tolerances in the procedure are given as calibration guides and are not intended to be instrument specifications.

The procedure assumes that (1) if a 137 is being checked or calibrated, the test signal generator being used has a color subcarrier frequency of 3.58 MHz and (2) if a 138 is being checked or calibrated, the test signal generator being used has a colour subcarrier frequency of 4.43 MHz.

The procedure uses the equipment listed in the Recommended Test Equipment. If substitute equipment is used, the procedure may need to be altered to meet the requirements of the substituted equipment.

Recommended Test Equipment. The following test equipment is required for the procedure. Specifications given are the minimum necessary for accurate evaluation of the Normalizers. All test equipment is assumed to be correctly calibrated and operating within the given specification. Other equipment may be substituted if it meets or exceeds the specifications of the recommended equipment.

1. Test Oscilloscope. Bandwidth, DC to 50 MHz; minimum deflection factor, 1 mV/division; two input channels providing choice of independent channel operation or differential operation. A Tektronix 7503 Oscilloscope with 7A13/7A18/7B50 Plug-In Units was used for the procedure.

2. Test Signal Generator. Tektronix 147 NTSC Test Signal Generator recommended for use with the 137; Tektronix 148 Insertion Test Signal Generator recommended for use with the 138.

3. Constant Amplitude Signal Generator. Frequency range, at least two times subcarrier frequency. A Tektronix Type 191 Constant Amplitude Signal Generator was used for the procedure.

4. Digital Voltmeter[2]. For example, Fluke Digital Voltmeter Model 8300A or Fairchild Digital Multimeter Model 7000A.

5. Vectorscope[3]. Tektronix Type 520 NTSC Vectorscope recommended for use with the 137. Tektronix Type 521 PAL Vectorscope recommended for use with the 138.

6. Return Loss Bridge. Tektronix Part No. 015-0149-00. (Includes two 75 Ω, within 0.5%, terminations matched to within 0.2%. Tektronix Part No. 011-0103-00 and 011-0103-01.)

7. Battery[2]. Voltage, 1.5 volts; size, "D" Cell. To be obtained locally.

8. Adapter[2]. Connectors, BNC Male to BNC Male. Tektronix Part No. 103-0029-00.

9. Adapter[2]. Connectors, BNC Female to Clip Leads. Tektronix Part No. 013-0076-00.

10. Potentiometer[2]. Resistance, 200 Ω; wattage, 2 watt; type, carbon with linear taper. To be obtained locally.

11. Termination. Connectors, BNC; impedance, 75 Ω; type, feed-thru. Tektronix Part No. 011-0055-00.

12. Terminations (three)[3]. Connector, BNC; impedance, 75 Ω; type, end-line. Tektronix Part No. 011-0102-00.

13. 50 Ω to 75 Ω Minimum Loss Attenuator. Tektronix Part No. 011-0057-00.

14. Cables (three or four[3]). Length, 42 inches; connectors, BNC; impedance, 75 Ω. Tektronix Part No. 012-0074-00.

15. Adjustment tools. To be obtained locally.

16. Jumper Wire[3]. To be obtained locally.

17. Miscellaneous hook-up wire[2]. To be obtained locally.

[2]Required only if desired to check dB attenuators, step 5 of procedure.

[3]Required only if desired to check or adjust phase shift, step 6 of procedure.

Procedure. The following is arranged in a sequence designed for checking or calibrating the Normalizers with minimum interaction of adjustments and reconnection of equipment. Steps titled "Check" or "Check/Adjust" are a combined procedure. When performing a Performance Check, ignore the ADJUST portion of the step.

1. Setup

a. (Calibration Procedure Only). Remove the top dust cover from the Normalizer. Ensure that all plug connectors (P1, P3, etc.) are in the normal position. (Normal position is shown on the diagram and is indicated on circuit board by black bars next to pins connected for normal operation.)

b. Connect the return loss bridge to the channel 1 and channel 2 inputs of the differential amplifier. The differential amplifier should be set for differential operation, using a vertical deflection factor of 1 mV/division. Both inputs should be DC coupled.

c. Externally trigger the test oscilloscope from the test signal generator composite sync output via a 75 Ω coaxial cable and 75 Ω termination. The sweep rate of the test oscilloscope should be 10 μs/division.

d. From the test signal generator full field output, connect a multiburst test signal to the input connector on the return loss bridge via a 75 Ω coaxial cable.

NOTE

For the 137, the peak to peak amplitude of the multiburst packets should be 90 IRE; for the 138, the peak to peak amplitude of the packets should be 700 mV.

e. Disconnect the red 75 Ω termination on the return loss bridge "Unknown" coaxial cable. Connect this termination to the Normalizer OUTPUT connector. Connect the "Unknown" coaxial cable on the return loss bridge to the Normalizer INPUT connector.

NOTE

The green 75 Ω termination must be connected to the "Reference" coaxial cable on the return loss bridge.

2. Check/Adjust Instrument Return Loss

a. Press the Normalizer BYPASS switch.

b. CHECK—Test oscilloscope display amplitude; should be (137) 0.8 mV peak to peak or less or (138) 0.875 mV peak to peak or less. This corresponds to 46 dB or less.

c. ADJUST—C1, see circuit board illustration on diagram pull-out page, for minimum return loss; repeat part b.

d. Set the test signal generator to provide a Modulated Sine-Squared Pulse test signal.

e. Press the Normalizer OPERATE OUT and BALANCE switches.

f. CHECK—Test oscilloscope display; peak to peak amplitude of modulated sine-squared pulse should be (137) 3.2 mV or less, or (138) 3.5 mV or less. This corresponds to 34 dB or less.

NOTE

For Performance Check, proceed to part o.

g. Set the test signal generator to provide the multiburst test signal.

h. Remove the connector on P5 and connect it to P3. Change the connector on P7 such that R3 is connected to R5.

i. ADJUST—L1 to minimize return loss at the lower frequencies.

ADJUST—L3 to minimize return loss at the higher frequencies.

NOTE

Repeat adjustment of L1 and L3 to reduce interaction.

j. Remove the connector on P1 and connect it to P5. Change the connector on P9 so that R13 is connected to R15.

k. ADJUST—L7 to minimize return loss at the lower frequencies.

ADJUST—L5 to minimize return loss at the higher frequencies.

NOTE

Repeat adjustment of L7 and L5 to reduce interaction.

l. Remove the connector on P3 and connect it to P1. Change the connectors on P7 and P9 so they are in the normal position.

m. ADJUST—(in listed order), L7 for minimum return loss at lower frequencies; L5 for minimum return loss at burst packet frequency, which is nearest the subcarrier frequency; L1 for minimum return loss at the lower frequencies; L3 for minimum return loss at burst packet frequency, which is nearest the subcarrier frequency.

NOTE

Repeat adjustments to reduce interaction.

n. Repeat part d and f. If part f is not within listed tolerances, repeat parts g through m before proceeding.

o. Press the CHROMINANCE switch.

p. Repeat part f.

q. Observing the test oscilloscope display amplitude, press each dB attenuator switch.

r. Repeat part f.

s. Press the LUMINANCE switch.

t. Repeat (in listed order) parts f, q, and f.

3. Check Insertion Loss

a. Disconnect the 75 Ω coaxial cable from the input on the return loss bridge. Disconnect the red 75 Ω termination on the Normalizer OUTPUT and connect the termination to the coaxial cable just disconnected from the return loss bridge. Now, connect the 75 Ω termination to the test oscilloscope vertical input.

b. Note and record the peak to peak amplitude of the test signal now being applied to the test oscilloscope vertical input.

c. Disconnect the "Unknown" coaxial cable of the return loss bridge from the Normalizer INPUT. Disconnect the 75 Ω coaxial cable from the red 75 Ω termination and connect the cable to the Normalizer INPUT. Connect a second 75 Ω coaxial cable from the Normalizer OUTPUT to the red 75 Ω termination connected to the test oscilloscope vertical input.

d. Press the Normalizer BYPASS switch.

e. CHECK—Test oscilloscope display amplitude; should be same as that noted and recorded in part b. (BYPASS insertion loss = 0 dB.)

f. Press the Normalizer OPERATE OUT and BALANCE switches.

g. CHECK—Test oscilloscope display amplitude; should be 1/5 of that noted in part b (OPERATE insertion loss = 14 dB within 0.2 dB).

4. Adjust CALIBRATE (Performance Check and Calibration Procedure)

NOTE

This adjustment does not correct for errors of the modulated sine-squared pulse, but compensates for small frequency response errors in the monitoring oscilloscope. See the Operating Instructions of this manual for further details.

a. Press the Normalizer BYPASS switch.

b. Observing the test oscilloscope display, note the shape of the modulated sine-squared pulse about its baseline. (The test oscilloscope sweep rate can be changed as desired for better viewing.)

c. Press the Normalizer OPERATE OUT switch.

d. Increase the test oscilloscope vertical gain 5 times.

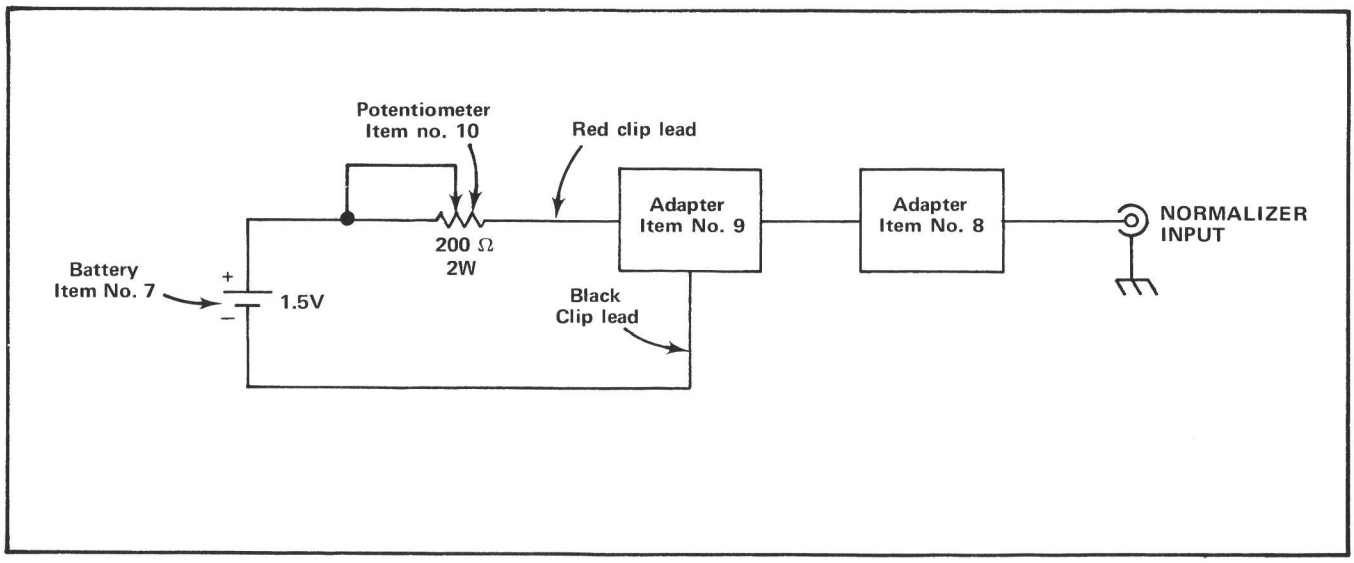


Fig. 6. Connections required at Normalizer INPUT for checking dB attenuators.

e. ADJUST–L13 (front-panel CALIBRATE) to match the shape of the modulated sine-squared pulse about its baseline with the shape noted in part b. (Relative chrominance/luminance gain variation of at least 0.3 dB.)

5. Check dB Attenuators

NOTE

The dB attenuators have been checked at the factory to be within 0.1 dB of indicated attenuation and should not require further attention. The attenuators can be checked as follows.

a. Disconnect all test equipment.

b. Press the Normalizer OPERATE OUT, LUMINANCE, 0 dB, and 0.0 dB switches.

c. From the Normalizer OUTPUT, connect a 75 Ω coaxial cable and 75 Ω termination to the digital voltmeter input.

d. Connect the INPUT of the Normalizer as shown in Fig. 6.

e. Observing the digital voltmeter readout, adjust the potentiometer to obtain a 100 mV output.

f. Using Table 3 as a guide, check each dB attenuator. Attenuation should be within 0.1 dB of indicated attenuation.

6. Check/Adjust Phase Shift

NOTE

The Normalizer has been calibrated at the factory for minimum phase shift. Unless adjustments L9 or L11 have been adjusted or replaced, it is recommended that the step not be performed. The phase shift can be checked and adjusted as follows.

a. Disconnect all test equipment.

b. Press the Normalizer OPERATE OUT, BALANCE, 0 dB, and 0.0 dB switches.

c. From the test signal generator full field output, connect a 75 Ω coaxial cable to the Normalizer INPUT. Connect a 75 Ω coaxial cable from the Normalizer OUTPUT to the vectorscope ch A input. Terminate the other ch A input into 75 Ω.

d. From the test signal generator CW subcarrier output, connect a 75 Ω coaxial cable to the vectorscope ext ϕ ref connector. Terminate the other ext ϕ ref into 75 Ω.

TABLE 3

dB to mV Conversion Chart
(100 mV reference)

dB	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	100.0	98.85	97.72	96.62	95.50	94.41	93.33	92.26	91.21	90.16
1	89.13	88.10	87.10	86.10	85.11	84.14	83.18	82.22	81.28	80.35
2	79.43	78.52	77.63	76.74	75.86	74.99	74.13	73.28	72.44	71.62
3	70.79	69.98	69.19	68.39	67.61	66.84	66.07	65.32	64.57	63.83
4	63.10	62.38	61.66	60.96	60.26	59.56	58.89	58.21	57.50	56.89

NOTE

5 dB = 56.23

e. From the test signal generator composite sync output, connect a 75 Ω coaxial cable to the vectorscope ext sync connector. Terminate the other ext sync connector into 75 Ω.

f. Set the test signal generator to provide a Modulated Sine-Squared Pulse test signal. The sine-squared pulse modulation should not be phase modulated.

NOTE

If using a Tektronix 147 or 148 as the test signal generator, see the operating instruction section of the appropriate manual for details on obtaining a modulated sine-squared pulse with modulation phase fixed.

g. Set the vectorscope for a vector display of the ch A input signal, using external ϕ reference, maximum gain, and external sync.

h. Observing the vectorscope display, use the vectorscope channel A phase control to align the vector representing pulse phase to a reference graticule line.

i. Observing the vectorscope display, switch the Normalizer between BALANCE and CHROMINANCE, and BALANCE and LUMINANCE.

j. CHECK—Vectorscope display; there should be little or no shift of the pulse vector as the Normalizer switches are changed.

NOTE

For Performance Check, proceed to step 7.

k. ADJUST—L11 for no shift of the vector as the Normalizer is switched between BALANCE and CHROMINANCE.

l. Remove the connectors on P7 and P9. Using the shortest jumper possible, connect P7 and P9 such that R13 is connected to P7.

NOTE

This connection is indicated by a dashed line on the circuit diagram between P7 and P9.

m. ADJUST—L9 for no shift of the vector as the Normalizer is switched between BALANCE and LUMINANCE.

n. Remove the jumper on P7 and P9. Connect P7 and P9 to the normal position.

o. Repeat parts i and j.

7. Check/Adjust Subcarrier 2nd Harmonic Attenuation

a. Disconnect all test equipment.

b. From the constant amplitude signal generator, connect a 50 Ω to 75 Ω minimum loss attenuator and a 75 Ω coaxial cable to the Normalizer INPUT.

NOTE

For the 137, the frequency of the generator should be 7.16 MHz; for the 138, the frequency should be 8.87 MHz.

c. From the Normalizer OUTPUT, connect a 75 Ω coaxial cable and the red 75 Ω termination to the test oscilloscope vertical input. The vertical deflection should be 20 mV/division and DC coupled.

d. Press the Normalizer OPERATE OUT and BALANCE switches.

e. Observing the test oscilloscope display, set the output of the constant amplitude signal generator for a peak to peak display amplitude of 100 mV.

f. Press the Normalizer OPERATE IN switch.

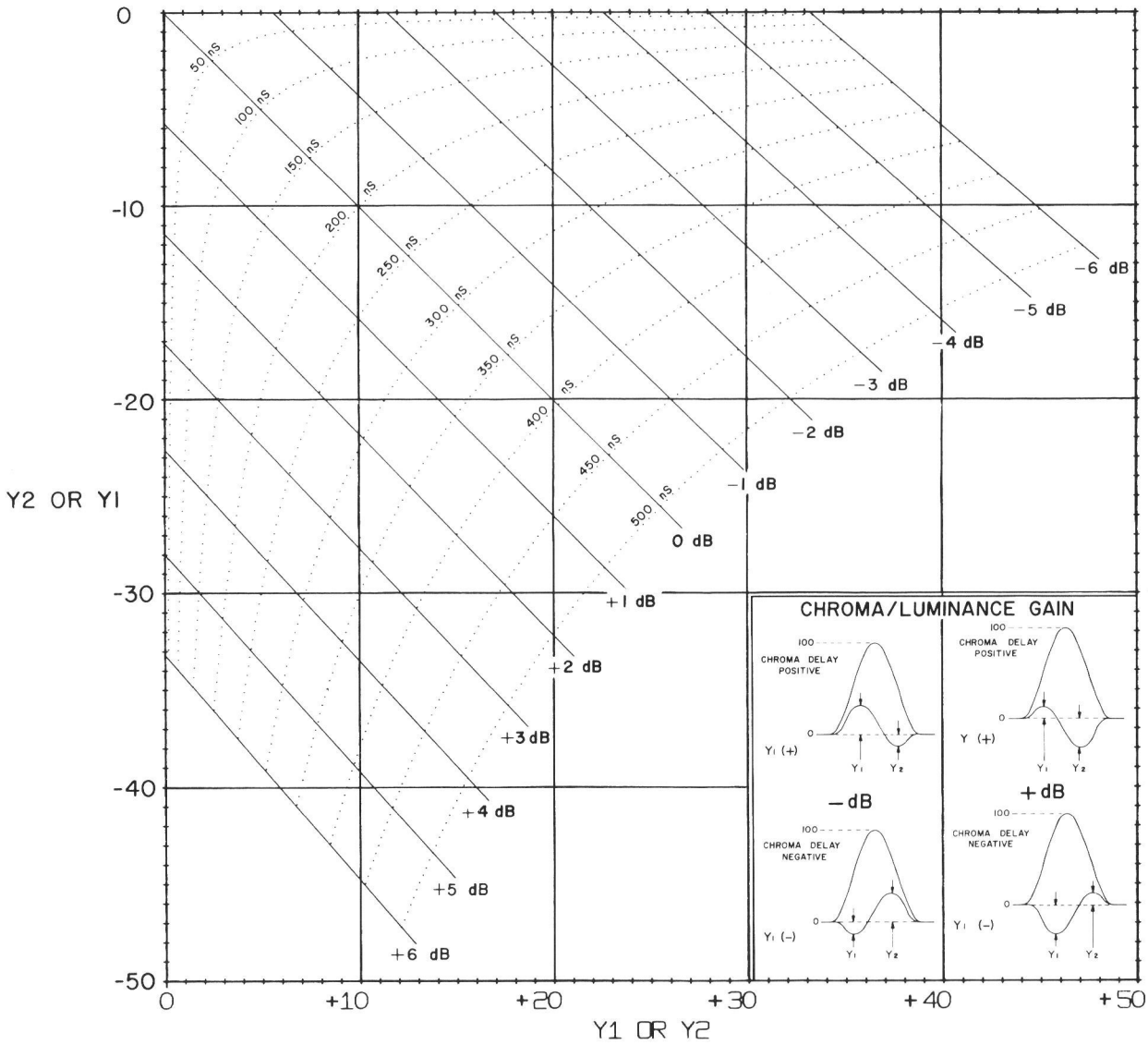
g. CHECK—Test oscilloscope display amplitude; should be 10 mV or less (20 dB).

h. ADJUST—L15 for minimum subcarrier 2nd harmonic; should be 10 mV or less.

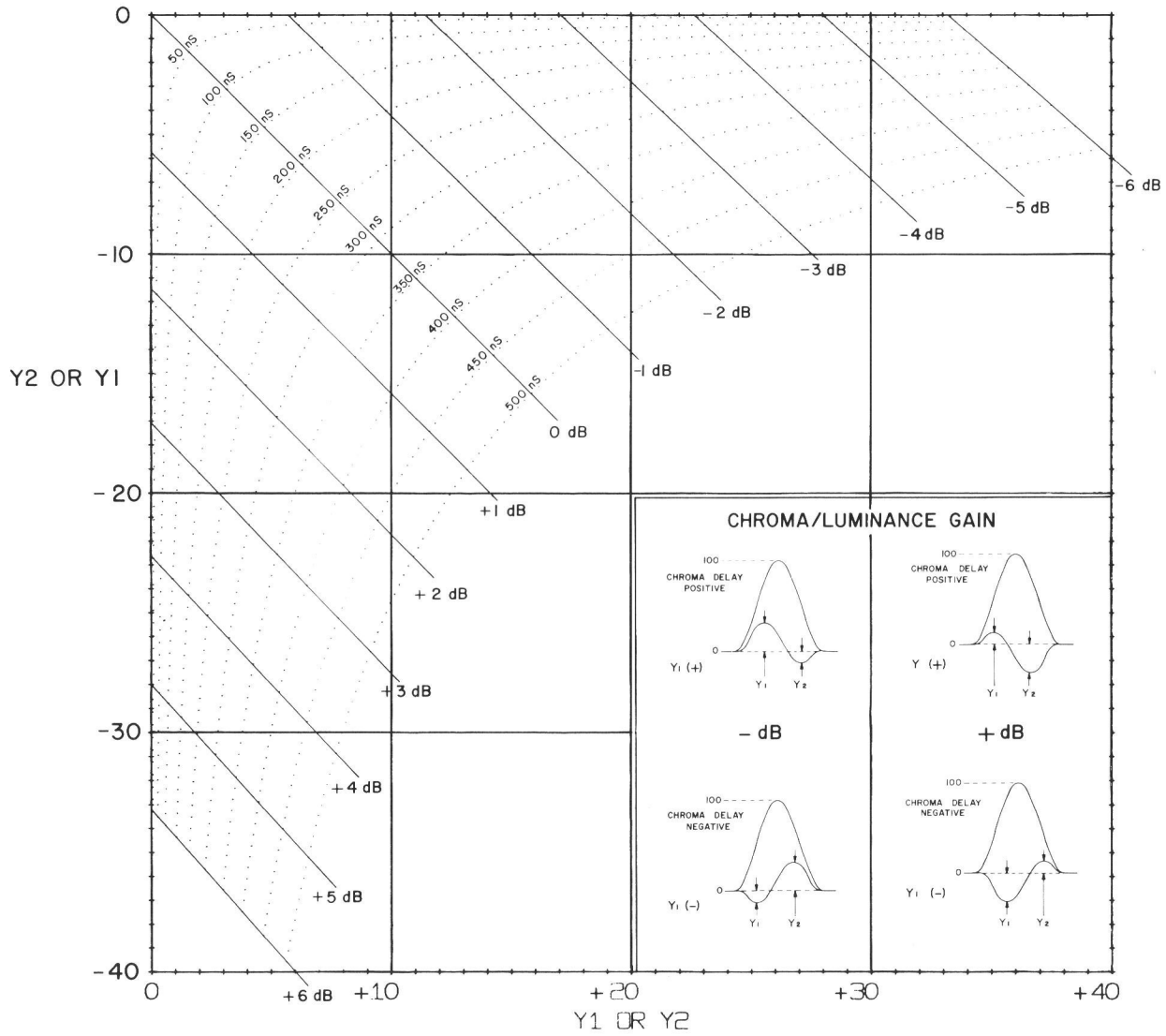
i. Disconnect all test equipment.

This completes the Performance Check/Calibration of the Normalizer. Replace the top dust cover (complete calibration procedure only).

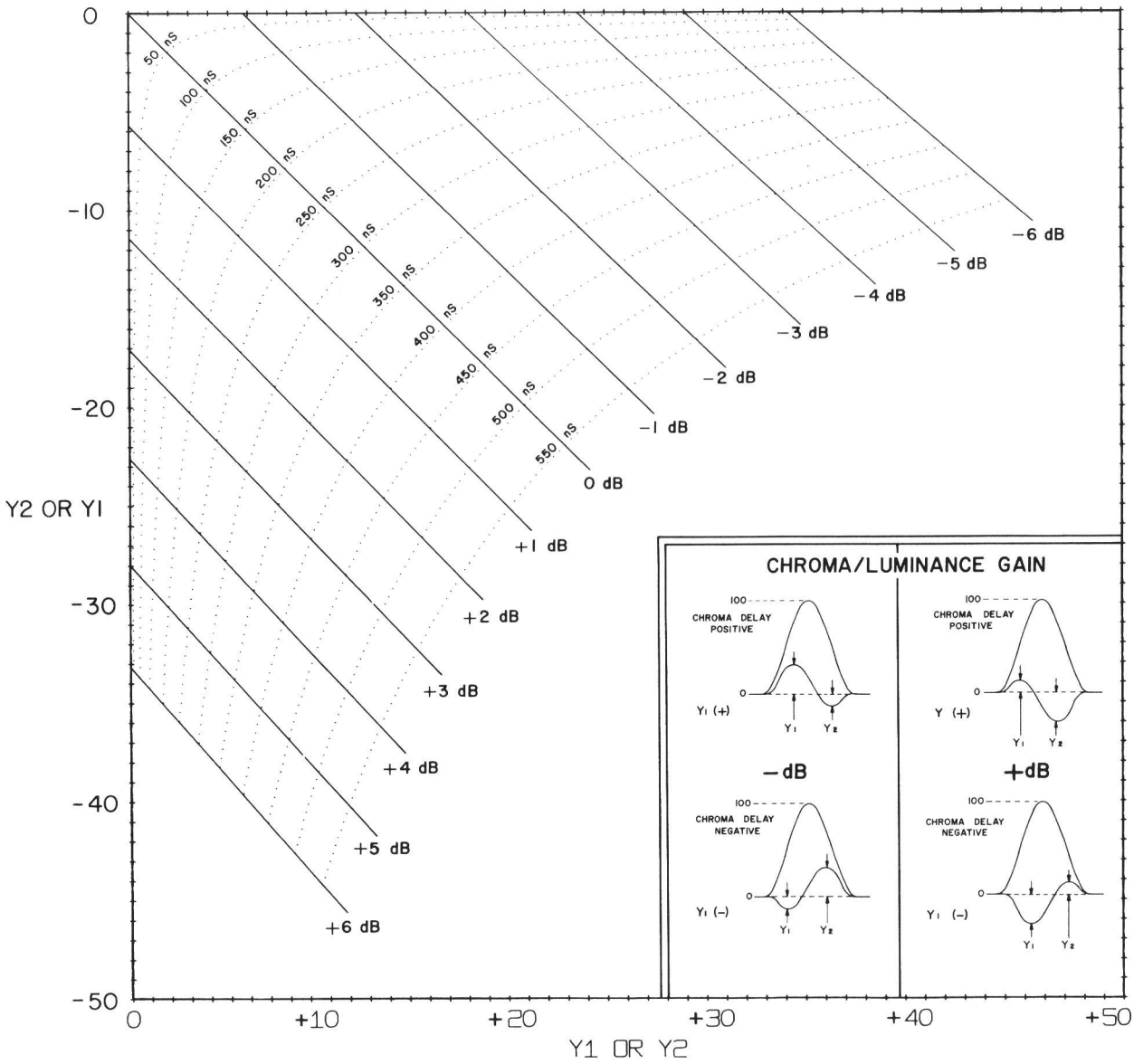
MODULATED SIN^2 PULSE APPLICATION NOMOGRAPH
12.5T 1.57 µsec h.a.d. FOR 525/60 STANDARDS



MODULATED SIN^2 PULSE APPLICATION NOMOGRAPH
20T 2.5 μsec h.a.d. FOR 525/60 STANDARDS



MODULATED SIN^2 PULSE APPLICATION NOMOGRAPH
20T 2.0 μsec h.a.d. FOR 625/50 STANDARDS



ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL	Filter	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable	H	Heat dissipating device (heat sink, etc.)	R	Resistor, fixed or variable
B	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or non-repairable
CRT	cathode-ray tube	M	Meter	V	Electron tube
DL	Delay line	Q	Transistor or silicon-controlled rectifier	Var	Variable
DS	Indicating device (lamp)	P	Connector, movable portion	VR	Voltage regulator (zener diode, etc.)
Elect.	Electrolytic	PMC	Paper, metal cased	WW	wire-wound
EMC	electrolytic, metal cased	PT	paper, tubular	Y	Crystal
EMT	electrolytic, metal tubular				
F	Fuse				

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLY				
A1	670-2101-00			MAIN Circuit Board Assembly
CAPACITORS				
C1	281-0091-00			2-8 pF, Var, Cer
C2	283-0672-00			200 pF, Mica, 500 V, 1%
C3	283-0631-00			95 pF, Mica, 100 V, 1%
C5	283-0672-00			200 pF, Mica, 500 V, 1%
C7	283-0631-00			95 pF, Mica, 100 V, 1%
C9	283-0672-00			200 pF, Mica, 500 V, 1%
C11	283-0631-00			95 pF, Mica, 100 V, 1%
C13	283-0672-00			200 pF, Mica, 500 V, 1%
C15	283-0631-00			95 pF, Mica, 100 V, 1%
C17	281-0577-00			14 pF, Cer, 500 V, 5%
C19	281-0577-00			14 pF, Cer, 500 V, 5%
C21	283-0641-00			180 pF, Mica, 100 V, 1%
C23	283-0674-00			85 pF, Mica, 500 V, 1%
CONNECTORS				
J1	131-0126-00			Receptacle, electrical, BNC, female
J3	131-0126-00			Receptacle, electrical, BNC, female
INDUCTORS				
L1	114-0235-00			6-12 µH
L3	114-0235-00			6-12 µH
L5	114-0235-00			6-12 µH
L7	114-0235-00			6-12 µH
L9	114-0322-00			200-400 nH
L11	114-0322-00			200-400 nH
L13	114-0321-00			4-8.3 µH
L15	114-0325-00			2.4-6.7 µH

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS				
R1	321-0114-00			150 Ω, 1/8 W, 1%
R3	321-0114-00			150 Ω, 1/8 W, 1%
R5	321-0114-00			150 Ω, 1/8 W, 1%
R7	321-0114-00			150 Ω, 1/8 W, 1%
R9	321-0114-00			150 Ω, 1/8 W, 1%
R11	315-0103-00			10 kΩ, 1/4 W, 5%
R13	321-0114-00			150 Ω, 1/8 W, 1%
R15	321-0114-00			150 Ω, 1/8 W, 1%
R17	321-0114-00			150 Ω, 1/8 W, 1%
R19	321-0114-00			150 Ω, 1/8 W, 1%
R21	321-0184-00			806 Ω, 1/8 W, 1%
R23	321-0075-00			59 Ω, 1/8 W, 1%
R25	321-0184-00			806 Ω, 1/8 W, 1%
R27	321-0184-00			806 Ω, 1/8 W, 1%
R29	321-0075-00			59 Ω, 1/8 W, 1%
R31	321-0184-00			806 Ω, 1/8 W, 1%
R33	321-0035-00			22.6 Ω, 1/8 W, 1%
R35	321-0222-00			2 kΩ, 1/8 W, 1%
R37	321-0222-00			2 kΩ, 1/8 W, 1%
R39	321-0059-00			40.2 Ω, 1/8 W, 1%
R41	321-0198-00			1.13 kΩ, 1/8 W, 1%
R43	321-0198-00			1.13 kΩ, 1/8 W, 1%
R45	321-0075-00			59 Ω, 1/4 W, 1%
R47	321-0184-00			806 Ω, 1/8 W, 1%
R49	321-0184-00			806 Ω, 1/8 W, 1%
R51	321-0086-00			76.8 Ω, 1/8 W, 1%
R53	321-0173-00			619 Ω, 1/8 W, 1%
R55	321-0173-00			619 Ω, 1/8 W, 1%
R57	321-0096-00			97.6 Ω, 1/8 W, 1%
R59	321-0165-00			511 Ω, 1/8 W, 1%
R61	321-0165-00			511 Ω, 1/8 W, 1%
R62	321-0114-00			150 Ω, 1/8 W, 1%
R63	321-0053-00			34.8 Ω, 1/8 W, 1%
R64	321-0114-00			150 Ω, 1/8 W, 1%
R65	321-0204-00			1.3 kΩ, 1/8 W, 1%
R67	321-0204-00			1.3 kΩ, 1/8 W, 1%
R69	321-0055-00			36.5 Ω, 1/8 W, 1%
R71	321-0202-00			1.24 kΩ, 1/8 W, 1%
R73	321-0202-00			1.24 kΩ, 1/8 W, 1%
R75	321-0057-00			38.3 Ω, 1/8 W, 1%
R77	321-0200-00			1.18 kΩ, 1/8 W, 1%
R79	321-0200-00			1.18 kΩ, 1/8 W, 1%
R81	321-0059-00			40.2 Ω, 1/8 W, 1%
R83	321-0198-00			1.13 kΩ, 1/8 W, 1%
R85	321-0198-00			1.13 kΩ, 1/8 W, 1%
R87	321-0061-00			42.2 Ω, 1/8 W, 1%
R89	321-0197-00			1.1 kΩ, 1/8 W, 1%
R91	321-0197-00			1.1 kΩ, 1/8 W, 1%
R93	321-0062-00			43.2 Ω, 1/8 W, 1%
R95	321-0195-00			1.05 kΩ, 1/8 W, 1%

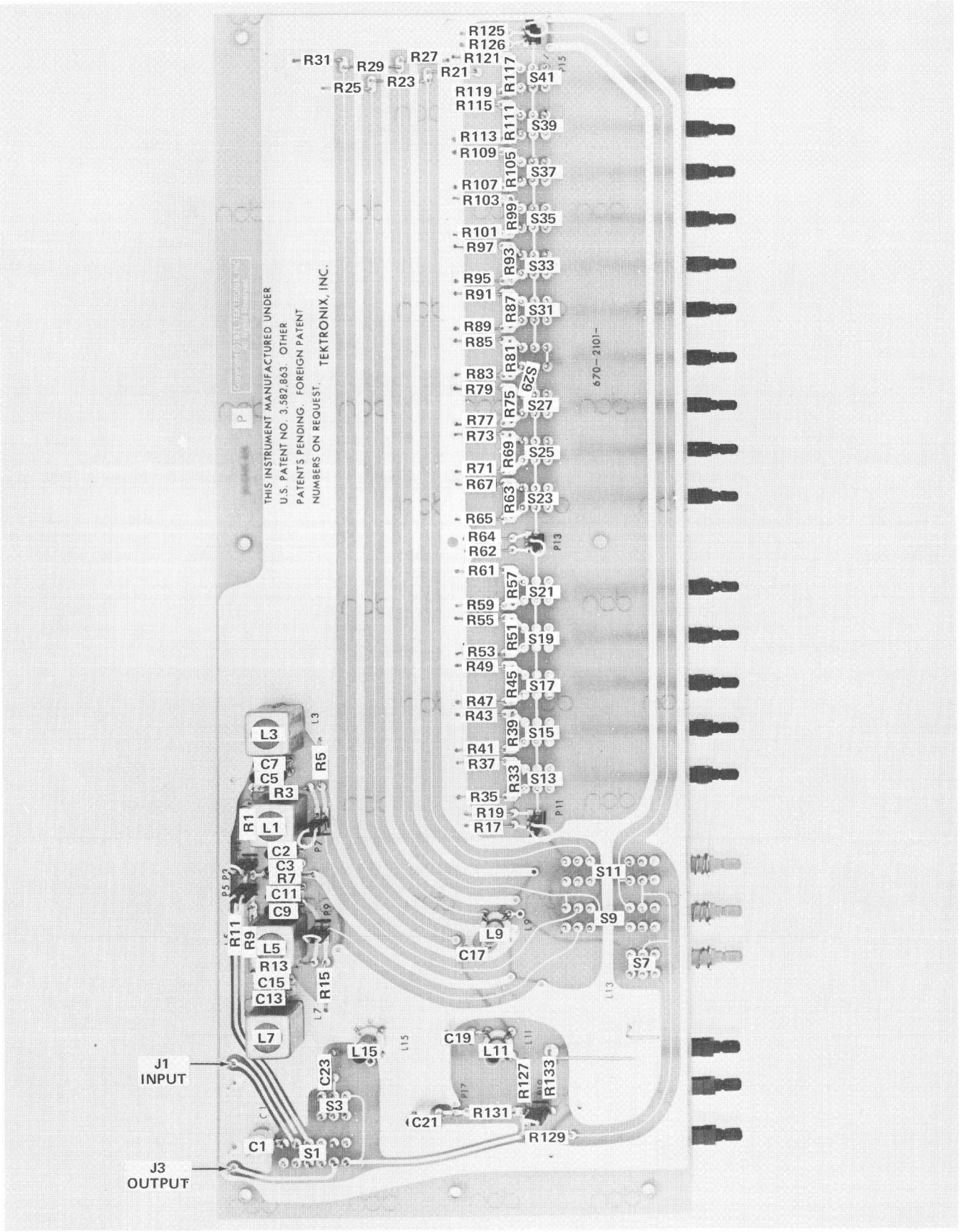
Ⓐ

ELECTRICAL PARTS LIST (cont)

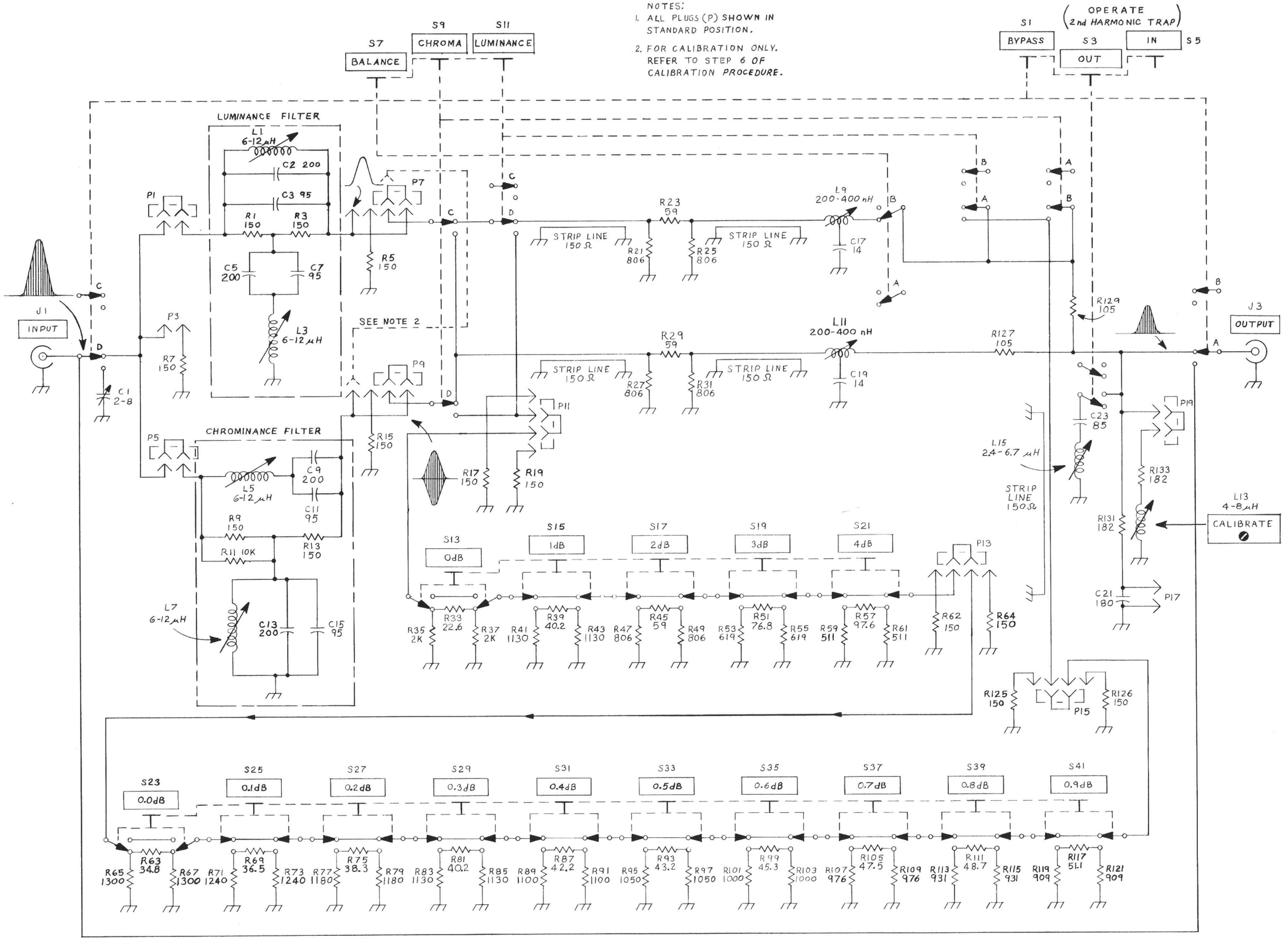
Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R97	321-0195-00			1.05 kΩ, 1/8 W, 1%
R99	321-0064-00			45.3 Ω, 1/8 W, 1%
R101	321-0193-00			1 kΩ, 1/8 W, 1%
R103	321-0193-00			1 kΩ, 1/8 W, 1%
R105	321-0066-00			47.5 Ω, 1/8 W, 1%
R107	321-0192-00			976 Ω, 1/8 W, 1%
R109	321-0192-00			976 Ω, 1/8 W, 1%
R111	321-0067-00			48.7 Ω, 1/8 W, 1%
R113	321-0190-00			931 Ω, 1/8 W, 1%
R115	321-0190-00			931 Ω, 1/8 W, 1%
R117	321-0069-00			51.1 Ω, 1/8 W, 1%
R119	321-0189-00			909 Ω, 1/8 W, 1%
R121	321-0189-00			909 Ω, 1/8 W, 1%
R125	321-0114-00			150 Ω, 1/8 W, 1%
R126	321-0114-00			150 Ω, 1/8 W, 1%
R127	321-0099-00			105 Ω, 1/8 W, 1%
R129	321-0099-00			105 Ω, 1/8 W, 1%
R131	321-0122-00			182 Ω, 1/8 W, 1%
R133	321-0122-00			182 Ω, 1/8 W, 1%
SWITCHES				
S1[1]	260-1419-00			Push, BYPASS
S3[1]	260-1419-00			Push, OPERATE-OUT
S5[1]	260-1419-00			Push, OPERATE-IN
S7[2]	260-1418-00			Push, BALANCE
S9[2]	260-1418-00			Push, CHROMA
S11[2]	260-1418-00			Push, LUMINANCE
S13[3]	260-1230-00			Push, 0dB
S15[3]	260-1230-00			Push, 1dB
S17[3]	260-1230-00			Push, 2dB
S19[3]	260-1230-00			Push, 3dB
S21[3]	260-1230-00			Push, 4dB
S23[4]	260-1420-00			Push, 0.0dB
S25[4]	260-1420-00			Push, 0.1dB
S27[4]	260-1420-00			Push, 0.2dB
S29[4]	260-1420-00			Push, 0.3dB
S31[4]	260-1420-00			Push, 0.4dB
S33[4]	260-1420-00			Push, 0.5dB
S35[4]	260-1420-00			Push, 0.6dB
S37[4]	260-1420-00			Push, 0.7dB
S39[4]	260-1420-00			Push, 0.8dB
S41[4]	260-1420-00			Push, 0.9dB

[1]Furnished as a unit, S1, S3 and S5.
[2]Furnished as a unit, S7, S9 and S11.
[3]Furnished as a unit, S13, S15, S17, S19, and S21.
[4]Furnished as a unit, S23, S25, S27, S29, S31, S33, S37, S39 and S41.

Ⓐ


THIS INSTRUMENT MANUFACTURED UNDER
U.S. PATENT NO. 3,582,863. OTHER
PATENTS PENDING. FOREIGN PATENT
NUMBERS ON REQUEST. TEKTRONIX, INC.
670-2101-
J1
INPUT
J3
OUTPUT

NOTES:
1. ALL PLUGS (P) SHOWN IN STANDARD POSITION.
2. FOR CALIBRATION ONLY. REFER TO STEP 6 OF CALIBRATION PROCEDURE.

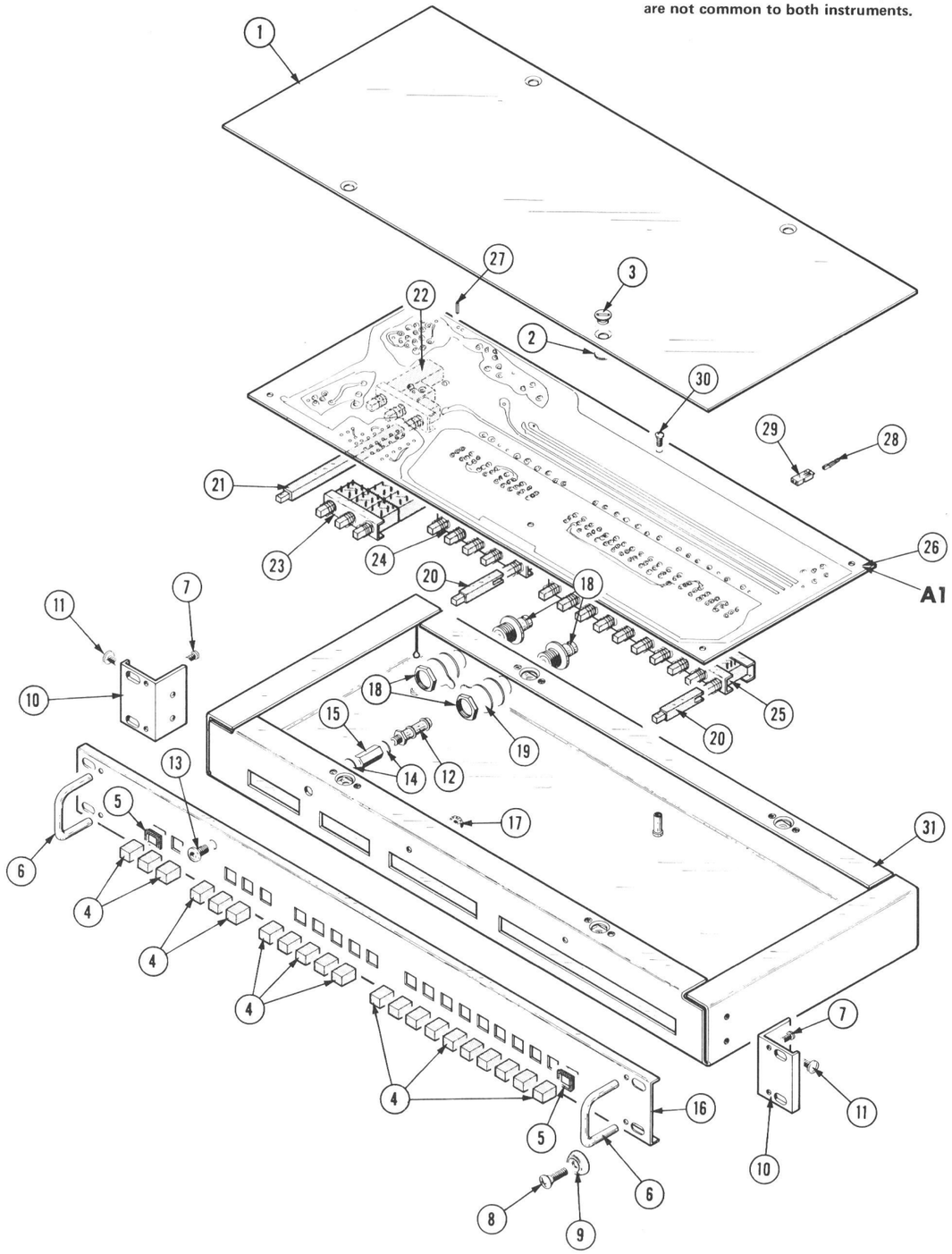


Ⓐ

CHROMINANCE / LUMINANCE GAIN NORMALIZER

M.E.B 0172

Black reference numbers denote parts which are not common to both instruments.



137 and 138 CHROMINANCE/LUMINANCE GAIN NORMALIZER Ⓐ

MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

BHB	binding head brass	h	height or high	OHB	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	HHB	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	OD	outside diameter	w	wide or width

FIGURE 1 EXPLODED & STANDARD ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-1	390-0275-00			1		CABINET TOP
	- - - - - -			-		cabinet top includes:
-2	214-0389-00			4		FASTENER, retainer
-3	355-0172-00			4		STUD, turnlock fastener
-4	366-1328-00			21		PUSHBUTTON, gray
-5	426-0681-00			21		FRAME, pushbutton
-6	367-0160-00			2		HANDLE, carrying
	- - - - - -			-		mounting hardware for each: (not included w/handle)
-7	211-0097-00			2		SCREW, 4-40 x 0.312 inch, PHS
-8	212-0591-00			4		SCREW, 10-32 x 0.75 inch, OHS
-9	210-1143-00			4		WASHER, plastic finishing
-10	407-1073-00			2		BRACKET, angle
	- - - - - -			-		mounting hardware for each: (not included w/bracket)
-11	212-0068-00			2		SCREW, 8-32 x 0.312 inch, THS
-12	- - - - - -			1		COIL
	- - - - - -			-		mounting hardware: (not included w/coil)
-13	358-0054-00			1		BUSHING, banana jack
-14	210-0046-00			2		WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-15	129-0373-00			1		POST, hex., 0.312 x 0.60 inch long
-16	333-1590-00			1		PANEL, front (138 only)
	333-1589-00			1		PANEL, front (137 only)
	- - - - - -			-		mounting hardware: (not included w/panels)
-17	210-0457-00			2		NUT, keps, 6-32 x 0.312 inch

Ⓐ

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-18	131-0126-00			2	CONNECTOR, receptacle, BNC, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-19	210-0241-00			1	LUG, terminal, 0.515 ID x 0.625 inch OD
-20	384-1099-00			15	SHAFT, extension, 1.54 inches long
-21	384-1101-00			3	SHAFT, extension, 4.13 inches long
-22	260-1419-00			1	SWITCH, push, 3 button--BYPASS OPERATE
-23	260-1418-00			1	SWITCH, push, 3 button--BALANCE, CHROMA, LUMINANCE
-24	260-1230-00			1	SWITCH, push, 5 button--0dB to 4dB
-25	260-1420-00			1	SWITCH, push, 10 button--0.0dB to 0.9dB
-26	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--MAIN (A1 see electrical list)
	- - - - - -			-	cirucit board assembly includes:
	388-2640-00			1	CIRCUIT BOARD
-27	131-0608-00			34	TERMINAL, pin, 0.365 inch long
	131-0993-00			8	LINK, terminal connecting
	- - - - - -			-	each link includes:
-28	131-0707-00			2	CONNECTOR, terminal
-29	352-0169-00			1	HOLDER, terminal connector, 2 wire (black)
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-30	211-0097-00			6	SCREW, 4-40 x 0.312 inch, PHS
-31	441-1071-00			1	CHASSIS, main
					STANDARD ACCESSORIES
	070-1311-00			1	MANUAL, instruction (not shown)

CARTON ASSEMBLY
(Part No. 065-0165-00)

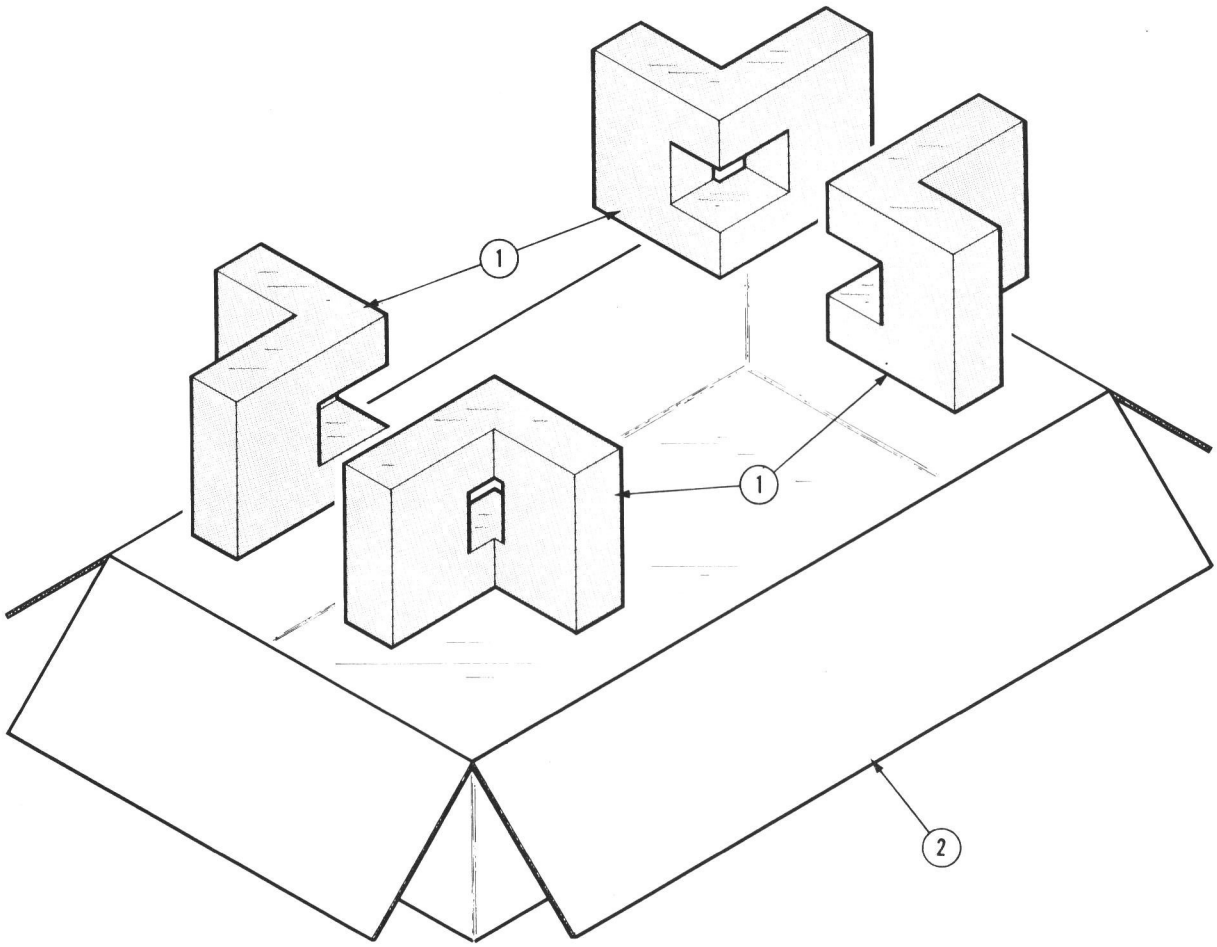


FIG. 2 REPACKAGING

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
2-	065-0165-00			1		CARTON ASSEMBLY
	- - - - - - - - - -			-		carton assembly includes:
-1	004-0294-00			4		CORNER BLOCKS, plastic foam
-2	004-0810-00			1		CARTON

+Ⓐ